July 10, 1961

STATINTL [redacted]

Re: 10-20-40X Enlarger

In accordance with your message 1731 and a later telephone conversation with Joe P., I am submitting herewith a proposal to provide ten (10) each 10-20-40X enlargers in accordance with Design Specification dated 20 June 1961 enclosed herewith.

Ten 10-20-40X Enlargers
7% Fee

Total Estimated Cost STATINTL [redacted]

The above includes the enlargers, spare parts on the FAK-Depot breakdown principle (it would be fantastically expensive to provide full spare parts for each unit) a commercial type manual, and delivery .la military air or commercial truck.

The above is somewhat higher than the [redacted] previously STAT estimated before we commenced design, but we have made a number of improvements, some at our own instigation and some requested by [redacted] during his design review of 26 May 1961. Some of these are:

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1. Time to change magnification reduced from 3 hours to 10 minutes or less.
2. Fixed mechanical easel changed to vacuum type with 180° rotation.
3. Variac added to increase flexibility of timer.
4. Coordinate search mechanism added for quick selection of area to be printed.
5. [redacted] exposure monitor provided.

25X1

I am somewhat confused by your request to show the cost of making one unit only so I will give it to you two ways.

Assuming that only one unit was to be made:

Estimated Cost
7% Fee

Total Estimated Cost STATINTL [redacted]

Assuming that the first unit of ten has to absorb all of the Design Engineering and non-recurring costs:

Estimated Cost [redacted] STATINTL
7% Fee

Total Estimated Cost [redacted] STATINTL

This compares with an estimated cost of [redacted] if costs are prorated over 10 units.

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I am very enthusiastic about this piece of equipment. There have been many complimentary comments concerning the old 20X enlarger, but it is a Model-T compared to what I expect this one to be. I strongly recommend that you add [redacted] plus a fee [redacted] to your order and allow us to make one for use here. We will definitely need it to monitor and improve our processing and reproduction techniques in connection with C[redacted], M & O. As you know, we do not have one of the 20X enlargers. STATINTL

I am having made an investigation of the photographic titlers with a view to re-estimating them. Before I submit a proposal, however, I want to review the problem with some of the users. They may not really need the device.

E. L. G.

ELG/MDG
cc: A.B.S.
F.G.F.
J.L.B.

Encls. (10)

Revised: July 10, 1961

ENCL #1

DPD 4330-61
COPY 3 OF 10

DESIGN SPECIFICATIONS

FOR 10-20-40X PRECISION ENLARGER

I. GENERAL DESCRIPTION

The enlarger will be used to make high quality 10-20-40X enlargements from portions of aerial photographs respectively .900 x .900; .450 x .450; .225 x .225. Accommodation will be provided for the following unperforated film: 70mm (2.754"±.010), 5" (4.960"±.010), 6.6" (6.590"±.010), 7" (6.991"±.010), 8" (7.960"±.010), and 9½" (9.460"±.010). With relatively minor modifications, the enlarger can be adapted to accept other sizes. The selected sections will be enlarged, through a liquid gate, to form an image on a 9 x 9 area on a 10 x 12 sheet film held flat by a vacuum easel. The condensing system, the objective lens, and mechanical components will be designed to give optimum resolving power under these conditions.

II. PHOTOGRAPHIC MATERIALS TO BE HANDLED

A. The photography will be supplied on spools 70mm to 9½" wide. It may also be supplied on two spools; that is, the film may have been partially wound onto a take-up spool.

B. The aerial film will be supplied in lengths up to 500 feet. The first and last frame to be exposed, however, will be at least 50" from the end of the roll.

C. The raw stock used will be 10 x 12 sheet film. The photographic exposure will be in the spectral range 4100A to 4300A. Glass plates 9½" x 9½" in thicknesses of .060", .120", and .210" may be exposed without the use of border mask and titling.

III. GENERAL CONSTRUCTION

A. Over-all Arrangement

1. The optical and mechanical assemblies that make up the enlarger will be mounted on a rigid metal frame. The upper portion of the unit will consist of the lamphouse, condensers, supply and take-up

provides, film gate with liquid injectors, and sprocket idler rollers.

tension rollers, mechanical film transport controls, illuminator box, and objective lens. The lower portion will consist of the easel and base for sheet film and glass plates.

2. The enlarger will be approximately 75" high, 54" wide (film flange to film flange), 41" deep and will weigh approximately 800 pounds. The Illuminator Sub-Assembly can be removed to reduce the depth to 34".

3. The enlarger base, will stand on the floor. The enlarger itself will be isolated from its base with vibration dampers.

4. The height of the negative gate will be approximately 57" above the floor and the height of the easel will be approximately 14".

B. Construction and Function of Main Components

1. The film supply and take-up will be motor driven to transport the film at a rate of about 60 feet per minute. The system will be designed to provide uniform tension on the web and provide maximum protection for the film. The even tension is maintained by controlling the supply and take-up torque, by the position of loaded tension arms. A three position momentary contact switch will, in one position, produce film transport from left to right and, in the opposite position, from right to left. Slow advances and precise positioning are accomplished by a hand knob. Pressure on the knob disconnects the clutch of the automatic drive allowing the film to be transported in either direction without drag from the drive train. Both supply and take-up will accommodate all the sizes specified (General Description) on standard aerial roll film spool up to 7 5/8" flange diameter (500 feet standard base film)

U.S. Air Force Spool	(70mm)
U.S. Air Force Spool	(5")
U. S. Air Force Spool	(6.6")
U.S. Air Force Spool	(7")
U.S. Air Force Spool	(8")
U.S. Air Force Spool	(9½")

Slight modifications of the system will permit the instrument to accept other widths as required.

2. The Film Gate will be of the liquid type; however, the film will not be submerged in a liquid. The liquid will be injected manually upon both sides of the film at the gate just prior to clamping for printing. The upper part of the gate will consist of a spring loaded condenser lens plano on the side which contacts the film. The lower part of the gate will consist of a disk (approximately 1.750" dia) of .125" optical glass with a refractive index of 1.523±.010 and of excellent surface quality. Both the upper and lower parts of the gate will remain fixed on the optical axis while the film is moved forward or backward in search of the area to be enlarged. (see Crossfeed) While the lower part of the gate is adjusted to fall exactly into the focal plane of the optical system, the upper or spring loaded part will move up approximately 6" to ease the interchanging of lenses. In its normal position, the upper gate will clear the lower gate by .060". This spacing will allow the film to pass freely and will also permit the injected liquid to wet the glass as well as the required negative area. In this position it will be possible to inspect the image on the easel prior to clamping. A downward movement of the condenser lens clamps the film under spring pressure during exposure. Interlocks on the film transport and crossfeed mechanisms prevent any movement of the film while it is clamped in expose position.

3. In changing magnification, a condenser lens and cell assembly between the lamphouse and the film will be replaced.

4. Objective Lens - Three quickly interchangeable lenses will be

Type 50mm f/2 for 20X magnification, a M-171D Type 26mm f/2 for 40X magnification. All three lenses will have fixed diaphragms. The resolving power of the negative material may range up to 200 lines per mm. The optical performance at 20X shall match that achieved in the 20X Precision Enlarger. Because of the increased geometrical aberrations of the lens as "scaled up" for 10X, the resolution at the negative may be decreased. Conversely, in the 40X system we may expect improved resolution in the order of 400 lines per mm or more in the center of the field. Test of the instrument should be made in the 4,100A to 4,300A range as limited by using a second order Fabry-Perot filter.

In changing magnification, a second assembly consisting of the lower plate of the negative gate and the objective lens will be replaced. A micrometric device to permit the lens to be focused relative to the gate is included in this assembly. Since the critical (for focus and alignment) dimensions of lens to gate relationships are set and held in this assembly, it is probable that test prints to verify enlarger alignment following magnification changeover will not be required.

NOTE: Storage space will be provided (integral with the instrument) for the lenses and other interchangeable assemblies.

5. The Film Transport Assembly will consist of a vertical plate straddling the lamphouse. This plate will hold the supply and take-up spindles with their cranks and clutches, idler and tension rollers as well as a pair of "static bar" units. This complete assembly will crossfeed back and forth on guide rods equipped with ball bushings. Two handles, one on each side of the enlarger, will permit the assembly to be pushed or pulled to position a designated

with the tension arm will insure that the film is pulled taut before it enters the squeegees. The movable assembly will be normally held stationary by a magnetic brake. In order to generate any movement it will be necessary to gently squeeze the handle located on the right as this pressure will release the brake. (This pressure also operates the squeegees). In order to safeguard the negative when the negative gate is closed, an interlock will override the ability of the "squeeze handle" to release the brake. The crossfeed will further allow the negative to be transported, past the optical axis, to position itself on a diffuse illuminator located in front of the enlarger. This illuminator will be large enough to permit inspection of the frame or code number on both edges of a full frame of the widest film (9½"). Furthermore, a metering device will determine the "across frame" co-ordinate of the area of the negative in the printing gate in respect to a selected "across frame" reference. (see Illuminator and Negative Area Selector)

6. A pair of Tubular Air Squeegees will be used to remove the liquid from the film. The squeegees will be mounted horizontally close to the negative gate, symmetrical to the gate and parallel to the film web. This unit will also be positioned at an angle of approximately 3° off the line perpendicular to the web in order to allow the edge of the film to progressively enter the squeegees. The film will be held taut by the Film Transport Assembly while it is crossfed between the squeegees. To remove liquid from the film, the Film Transport Assembly must be pulled forward to move the film through the squeegees.

The squeegee air supply is turned on by the same electrical circuit which releases the brake holding the film transport assembly.

As the film is moved through the squeegees, the liquid will be atomized and blown toward the back of the instrument where a hooded exhaust fan will carry the fumes away. Due to the requirements of this design, it will be necessary to move the film between the squeegees at times when no removal of liquid is desired. Whenever the film is in motion between them, the squeegees will be energized creating a cushion of air preventing scratches. To facilitate the interchanging of lenses, the squeegees will be pulled forward away from the gate.

7. The illuminator (approximately 10" x 10") will be located in front of the enlarger to permit inspection of a full width of the widest film (9½"). The unit will consist of a shallow box housing fluorescent lights and covered by a sheet of opal glass. This opal glass will be bisected by an index line directed from front to back, in line with the optical centerline (Y axis). A similar line (X axis) will be located toward the back of the glass and oriented at 90° to the Y axis. The top surface of the box will be free from any protrusions and sharp edges capable of scratching the film. The illuminator lamps will be controlled by a guarded toggle switch in front of the illuminator. The forward position of the transport assembly, where the film path is over the illuminator, is also the position for loading the negative.

The illuminator assembly and the air squeegees will be fastened to a common base so that both units can be pulled forward to provide space for the interchange of lenses.

8. The Co-ordinate Searching Mechanism - Given the X and Y co-ordinates (in-frame co-ordinates) of the center of a selected area of a negative, an operator will be able to position this area within

composed of the illuminator, one metering roller which measures millimeters and records on a dial the film length along the X axis and one roller and recorder which does the same on the Y axis without contacting the film. To find a given area designated by numerical values for X and Y, the negative is placed over the illuminator so that a selected index of the negative frame coincides with the Y axis and a similar index with the X axis. The X recording dial is zeroed and the film is transported until the X value is read. Then the film transport assembly is pushed to move the film along the Y axis until the dial reads the required value for Y. It is not necessary to zero the Y dial each time because it records from a fixed point. However, when changing negative sizes a quick adjustment of the metering mechanism is necessary to compensate for different fiducial mark location.

9. The lamphouse will have a 300 watt (ASA code CXP) biplane filament projection lamp to obtain a uniform illumination of the objective lens aperture. To insure that the exposure time is never less than that of which the timer is capable, a variable autotransformer is provided to control filament brightness. A 1% ammeter will be included in the circuit. A blower mounted off the enlarger frame will cool the lamphouse. The optical system will consist of three lenses for the first condenser, a heat absorber, a 45° front surfaced adjustable mirror, a holder for a color filter to improve the resolving power of the lens, a field lens, an adjustable iris diaphragm, and film plane condenser lenses. This unit at 20X will produce an exposure in 10 seconds on 7402 (Kodak Fine Grain Positive Film) with no negative in the gate which will develop to a density of 1.0 or greater with 3 minutes processing in DK-50 developer at

68°F. The exposure at 10X will be 50% to 75% less and at 40X 2 to 4 times greater. The three condenser elements nearest the film plane will be designed to be quickly interchangeable in a cell assembly with new condensers matching the 26mm (40X), 50mm (20X), and 93mm (10X) objective lenses. This condenser change will necessitate a vertical displacement of the lamphouse. This displacement will also be quickly achieved.

10. The easel will retain a sheet of film 10 x 12. This easel will hold the film flat by vacuum. Provision will be made to evacuate the air between the film and the "easel board" without causing any distortion of the emulsion side. A hinged mask, on top of the easel, will allow for a 9 x 9 image with a .25 maximum corner radius. Edge stops on the easel will provide margins ½" wide on three sides and 2½" wide on the fourth side. A pair of stencil printing boxes will be installed on the back of the mask. They will contact print type written identifications on the 2½" margin of the film. The easel assembly can be rotated without stops about the optical axis to provide any desired orientation of the image. Provision is also made for micrometer up and down adjustment and locking of this easel with a range of 2". This will permit the magnification for each of the lenses to be set to the nominal value within the limitations of the ability to measure magnification. When printing on glass plate, the easel will be adjusted to compensate for the greater thickness.

11. Air Pressure and Vacuum - A regulated oil free filtered air supply will be furnished for the air squeegees. At 50 pounds air pressure, one pair of air squeegees will consume about 15 cubic feet of air per minute. The vacuum will be used to hold the film on the easel. A vacuum pump and compressed air may be used with two separate tanks.

12. A print exposure monitoring system will be supplied. It will be based upon use of the Macbeth Quanta Log EP1000 (or equivalent) as a spot photometer.

13. The liquid injectors will consist of two pharmaceutical syringes modified to accommodate the 1,1,1 - trichloroethane and tetrachloroethylene. This liquid has an index of refraction equal to that of the film base (1.48±.02). The injectors are manually and simultaneously actuated by a lever on the left side of the enlarger. (refer to the Film Gate) The stroke of the lever will be adjusted so that only the required amount of liquid is dispensed.

14. The liquid reservoir consisting of a glass jar will be located as close as possible to the injectors. Three sizes will be available: 1 pint, 1 quart, and 2 quarts. These jars will be easily removable for cleaning.

15. An exhaust system to be connected to building air ducts will be provided to remove the fumes of the emersion liquid from the work area.

16. Two pairs of Static Eliminators will be provided.

17. The tension provided by the system described in item B-1 will keep the film taut, .030" above the lower gate. This tension is required to allow the film to pass between the squeegees. It also keeps the film flat to permit inspection of the image on the easel.

18. A stripper plate and roller assembly will be fitted around the lower negative gate. A polished guide plate with two highly polished rollers will prevent the edge of the film from stubbing against the lower gate and will also allow the wet film to detach itself from the gate where it might be held by surface tension. The top of the rollers will be .030 above the surface of the lower gate and the stripper plate .040 below the gate. This assembly will be easily lifted out to give access to the objective lens.

19. During the time that the negative is clamped in the gate, the motors on either the inner or outer frame of the enlarger will be automatically turned off.

IV. EXPECTED PERFORMANCE

A. The resolving power of the 70mm to 9½" negative film may be in the order of 100 or more lines per mm. It is desired to exploit as much of that definition as is possible. The enlarger and all of its components will be of high quality and will be adjusted to give maximum performance to provide a minimum of loss of information between the negative and the print.

B. The enlarger shall be rigid enough and shock mounted so that vibrations in the structure where the unit will be used will not cause deterioration of the image over the maximum exposure time under normal conditions.

C. The film gate shall be constructed so that scratches are minimized. Defects on the gate or bubbles in the liquid shall not be evident in the enlargement.

V. OPERATION

A. The work area will be at the front of the enlarger. The controls provided for moving the film in either direction will be positioned so that the operator can reach them conveniently while viewing the film on the illuminator.

B. Sequence of operation for loading the negative

1. Pull the Film Transport Assembly over the Illuminator.

2. Place the two reels over the spindles.

3. Thread the film.

C. Sequence of operation for changing magnification

1. Pull the Film Transport Assembly over the Illuminator.

2. Pull the Illuminator & Squeegees to front stop.

3. Lift on handle to raise Condenser barrel (Upper Gate); remove the barrel assembly.

4. Lift Stripper Plate and Roller Assemblies.

5. Remove objective lens.

6. Replace objective lens (different focal length).

7. Put Stripper Plate and Roller Assemblies back in place.

8. Replace Condenser barrel assembly corresponding to the objective lens.

9. Pull spring loading wrist pin and allow it to drop into appropriate hole. (This repositions the lamphouse.)

10. Push Illuminator and Squeegees in place.

11. Move the easel to preset position corresponding to the new magnification and/or use of glass plate.

12. Push down on handle to lower upper gate to "compose" position. Ready for operation. Approximate time 4 minutes.

D. Sequence of operation for enlarging

1. Find co-ordinates of area to be enlarged and slide under the gate.

2. Verify projection over the easel and orient easel if necessary.

3. Set timer.

4. Inject liquid.

5. Monitor exposure and set lamp brightness and timer.

6. Clamp gate.

7. Load easel.

8. Expose.

9. Remove exposed stock.

10. Lift gate.

11. Inject liquid (washing operation).

12. Pull Film Transport Assembly pass the Squeegees to the Illuminator.

13. Ready for selection of new area.

VI. MAINTENANCE

All parts will be accessible for lubrication and servicing.

VII. ENVIRONMENT

A. Space required for the enlarger to provide convenience in operation and maintenance should be approximately 8 ft wide and 7 ft deep.

B. The enlarger will be used in a photographic darkroom preferably air-conditioned, to be dust free and in a temperature range 60° to 85°F. Relative humidity is unimportant except as required by the sensitized goods and the negative.

C. The lamphouse will not permit extraneous light to escape into the room.

VIII. APPEARANCE

The exterior of the enlarger will be gray enamel; its interior will be dull black. The mechanism above the lens will be polished chrome and nickel plate or stainless steel except for the light path. This path will be dull black.

IX. ELECTRICAL SPECIFICATIONS

The enlarger shall operate on 115 volt, 60 cycle source of power. A commercial laboratory timer will be provided. The timer will be conveniently located for ease of operation. The air compressor and vacuum pump will operate on 115 volt, 60 cycle, single phase source of power.

X. OPERATING INSTRUCTIONS

Informal operating and maintenance instructions will be supplied, but no allowance is made for field trips, installation or servicing. A resolution chart and a magnification master chart will be supplied.

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